TUESDAY, AUGUST 23, 2005, P.M.

SESSION 31: INTERNATIONAL SYMPOSIUM ON PIPELINES FOR THE 21ST CENTURY IN HONOR OF DOUG BOYD

RESEARCH ON PIPELINE MATERIALS, PROTECTION AND SIMULATION
Sponsor(s): Material Performance and Integrity Section, The Metallurgical Society of CIM
Room: Imperial Ballroon 2
Chair(s): G.P. GU, CANMET, Canada

PAPER 31.1—14:00
MORPHOLOGY OF ENVIRONMENTALLY ASSISTED CRACKS IN PIPELINE STEEL.
B. WILLIAMS and A. PLUMTREE, University of Waterloo, Canada

The morphology of environmentally assisted cracks in stressed pipeline steel has been investigated. For a dilute and neutral solution (NS4) simulating ground water in contact with the steel, semi-elliptical cracks grow faster on the surface (2c) than in the depth (a), hence, the aspect ratio (a/c) decreases. This is explained using a deterministic concept since corrosion is dominant and the primary constraint is the conservation of charge. By contrast, when mechanistic conditions prevail, significant growth occurs in the depth. When underloads are imposed in the loading history, temporary accelerations in crack growth occur because corrosion rather than mechanical effects become dominant.

PAPER 31.2—14:25
ELECTROCHEMICAL BEHAVIOR OF AN X-80 PIPELINE STEEL DURING STRESS CORROSION CRACKING IN NEAR-NEUTRAL-PH ENVIRONMENT.
B. FANG, Chinese Academy of Sciences, China
M. ELBOUJDAÏNI, G.P. GU, J. LI and R.W. REVIE, CANMET, Canada and

Electrochemical behavior of an X-80 pipeline steel, including frequency-sweep electrochemical-impedance spectroscopy (EIS), time-sweep EIS at a constant frequency and open-circuit potential (OCP) monitor, was investigated using four-point bending specimens subjected to a stress-corrosion cracking (SCC) test in a near-neutral pH environment. The capacitive loop became smaller with test duration, revealing an increase in the corrosion rate. The resistance obtained in the constant-frequency EIS test showed two regions, of which the region with a market decrease in resistance transformed into a region of slow decrease, whereas the capacitance increased with test time indicating that iron dissolution was fast at first, and then a corrosion product or film formed and covered the surface, leading to the pitting formation.

PAPER 31.3—14:50
STRESS-CORROSION CRACK INITIATION BEHAVIOUR OF HIGH-STRENGTH PIPELINE STEEL IN NEAR-NEUTRAL PH ENVIRONMENT.
B. FANG, Chinese Academy of Sciences, China
M. ELBOUJDAÏNI, G.P. GU, J. LI and R.W. REVIE, CANMET, Canada and

Stress-corrosion cracking (SCC) tests were conducted in the near-neutral pH standard solution, NS4, and in an actual soil solution, using four-point bending at high a stress ratio and low frequency conditions very similar to those of operational pipelines. Pitting incubation appeared first and then pitting initiated and grew in both solutions although there were many more pits on the specimen tested in soil purged with 5% CO_2 + 95% N_2 than in the specimen tested in NS4 solution purged with the same gas. These observations show that samples in soil solution are more susceptible to pitting than those in NS4 solution. When the pist reached a critical size, the increased stress concentration around the pits, resulted in the transition to a crack.

COFFEE BREAK—15:15-15:45

PAPER 31.4—15:45
TEST AND RESEARCH ON HYDROGEN INDUCED CRACKING (HIC) RESISTANCE OF HIGH STRENGTH LINEPIPE STEELS.
Y. CHENXIAN, F. YAORONG, CNPC, China and
L. XINZHE, Xi'an University of Arch &. Tech, China

Many factors about the HIC (hydrogen-induced cracking) resistance of pipelines are discussed in this paper. The main factors that influence the ability of HIC are environmental and material factors. The chemical compositions, non-metal inclusions and microstructure are discussed in detail, while a group of tests on HIC resistance are done according

to varying C, S, Mn and P contents in pipeline steels, different experiment time and different strength to the coupon. It is concluded that decreasing the amount of C and S can obtain good HIC resistance; the test time has an effect on the different microstructure of X70; microstructure is the most sensitive factor for the initiation processes of HIC.

PAPER 31.5—16:10

COMPUTER VISION APPLIED TO CORROSION EVALUATION OF PIPES RADIOGRAPHS.

M. BROCHU, XperX Inc., Canada

P. NAUD, A. CHALIFOUR and Y. DUBÉ, Université du Québec à Trois-Rivières, Canada

In this paper, we present a computer-vision approach developed for wall-thickness measurements of corroded pipes inspected by double-wall radiography. The main objective of the work is to optimize data collection and film interpretation using computerized image analysis. To date, the system is able to identify the inner and outer contours of a pipe and perform wall thickness measurements at each pixel of a radiograph. This will be presented by analyzing pipes having different dimensions. Another important feature of the system concerns the algorithms' adaptability to pipe wall texture. In other words, image analysis is automatically refined around rough or corroded areas. This allows more precise thickness measurements and shape identification in critical sections as will be demonstrated with examples. Finally a brief overview of results exploitation will be given and compared with human interpretation. It will show the reliability of automated image analysis and the many possibilities offered by complete output analysis.